

EXPERIMENTAL AND SIMULATION ANALYSIS OF SPRING BACK IN THE CASE OF A CONICAL DRAW LIE MADE USING TOOLS CORRECTED BY APPLYING THE TAGUCHI METHOD OF OPTIMIZATION

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Abstract: Springback of draw parts considerably affects their accuracy and deviations from the theoretical profile, this instability phenomenon determining the following changes of the part shape and geometric parameters: arching of the part sidewall, modification of the angle formed by the part bottom and the sidewall, modification of the angle between the flange and the sidewall. Hence, in order to obtain the desired accuracy of the draw parts it is necessary the development of a method for the reduction or the elimination of the springback. The paper presents the results of an experimental analysis of the springback parameters resulted in the case of conical draw lied manufactured by using tools corrected in the designing stage by applying the optimization Taguchi's method.

Keywords: springback, conical draw lied, corrected tools, Taguchi's method

1. INTRODUCTION

Springback of draw parts considerably affects their accuracy and deviations from the theoretical profile, this instability phenomenon determining the following changes of the part shape and geometric parameters: arching of the part sidewall, modification of the angle formed by the part bottom and the sidewall, modification of the angle between the flange and the sidewall. Hence, in order to obtain the desired accuracy of the draw parts it is necessary the development of a method for the reduction or the elimination of the springback. An optimal solution can be obtained by using the process simulation in combination with a statistical modelling that allows the mathematical description of the influence of different process parameters on the draw part geometry and accuracy. For this purpose, the factorial design offers the possibility to use a statistical method – for example Taguchi method. This method uses some predefined tables and on their basis it is possible to establish the relative importance of process parameters and their interactions on the springback intensity. The Method is applied in the following six steps: 1. Definition of geometric parameters that characterize the geometric deviations of the part. 2. Selection of process parameters that influence the part geometry and its field of variation. 3. Selection of the model of linear or quadratic polynomial dependence and construction of fractioned factorial plane of experiment. 4. Process simulation according to experimental plane and the measurement of geometric deviations of the resulted parts. 5. Calculation of coefficients of the polynomial models and verification of the models. 6. Optimization of the process parameters in order to obtain the desired geometric parameters of the draw part.

The paper presents the results of an experimental and simulation analysis of the springback parameters resulted in the case of conical draw lied manufactured by using tools corrected in the designing stage by applying the Taguchi's method of optimization.

kN. The verification of the geometrical deviations of the draw pieces after drawing and after additional operations obtained from experimental investigations was performed by using a 3D scanning machine.

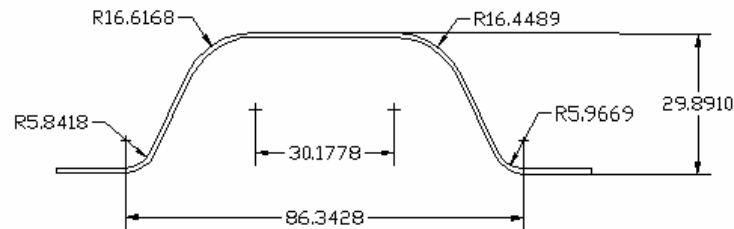


Fig.3 Conical draw lied resulted using corrected tool for BHF= 10 kN

Table 1

	R1 [mm]	R2 [mm]	R3 [mm]
Theoretical	5	15	41.5
Experimental	5.40435	15.53285	42.1714
Deviation	+0.40435	+0.53285	+0.6714

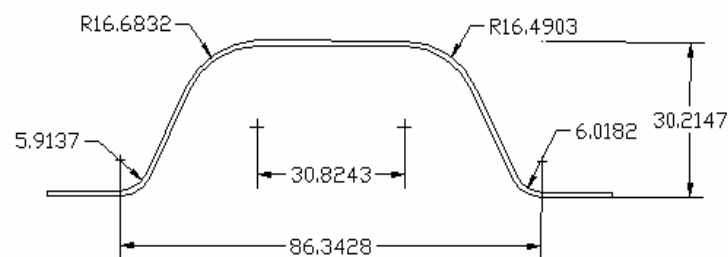


Fig.4 Conical draw lied resulted using corrected tool for BHF= 20 kN

Table 2

	R1 [mm]	R2 [mm]	R3 [mm]
Theoretical	5	15	41.5
Experimental	5.46595	15.58675	42.1714
Deviation	+0.46595	+0.58675	+0.6714

2.3 Verification by simulation of the optimized tools and process

Using the optimized tools and process parameter (blank holder force equal to 11kN) the resulted parts presents the geometry shown in Fig. 5 and the deviations given in Table 3.

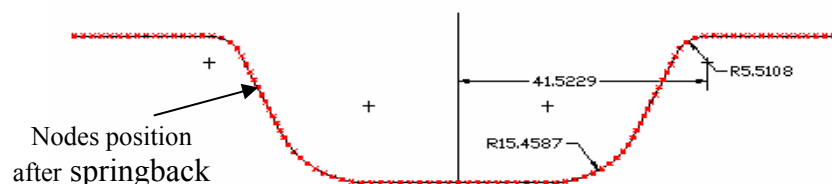


Fig.5. Conical draw lied resulted using corrected tool for BHF= 11 kN

Table 3

	R1 [mm]	R2 [mm]	R3 [mm]
Theoretical	5	15	41.5
Simulation	$5.5108-0.5=5.018$	$15.4587-0.5=14.9587$	41.5229
Deviations	+0.018	-0.0413	+0.229

3. CONCLUSIONS

1. The corrected tools were manufactured according to the geometry resulted by applying the optimization method. The experimentally and simulation investigations using the corrected tools were performed in the following working conditions: blank holder force BHF between 10 and 20 kN, friction coefficient $\mu = 0.15$.
2. The corrected tools allowed obtaining an improvement of shape accuracy of the draw parts by decreasing the springback parameters and deviations from the theoretical shape and dimensions compared to values obtained using the initial tools.
3. The values obtained from simulation are more much smaller compared with those obtained from experiment because in simulation we used the BHF value determined from application of the optimization method.

Acknowledgments

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